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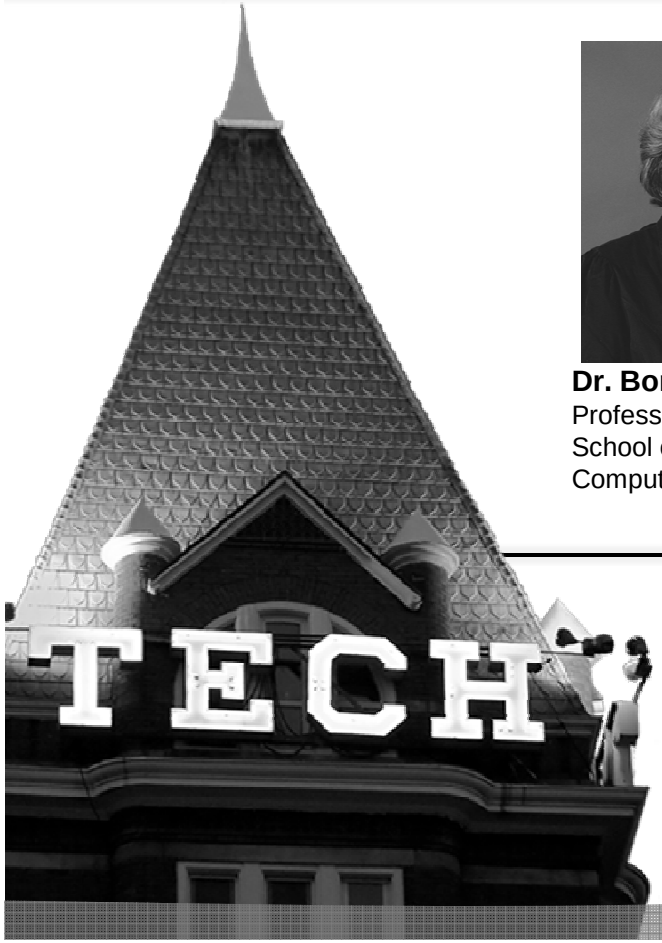


# Linear Circuits

**Dr. Bonnie Ferri**
Professor and Associate Chair
School of Electrical and
Computer Engineering

*An introduction to linear electric circuit elements and a study of circuits containing such devices.*

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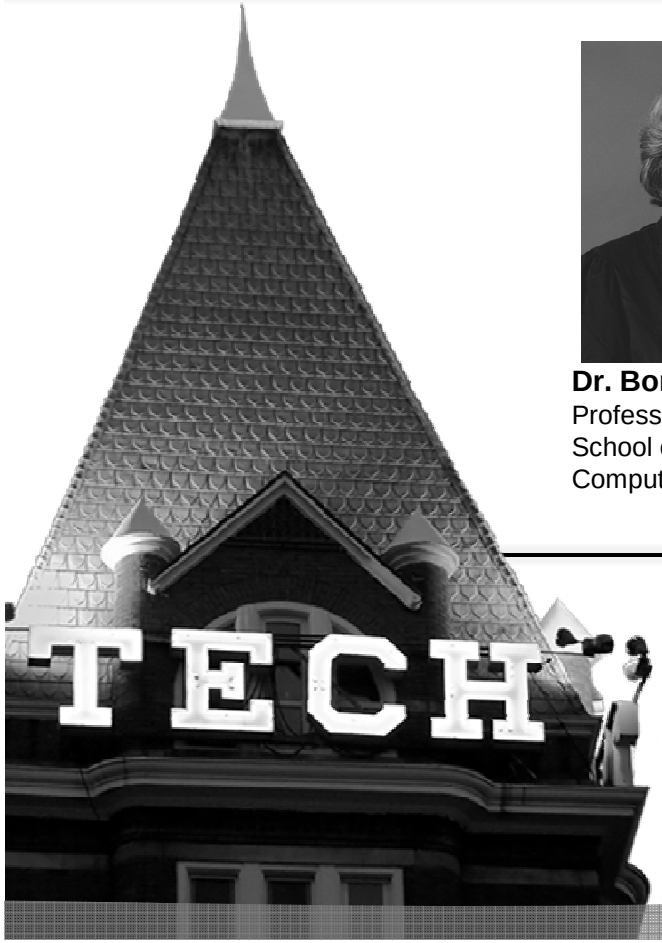



# Systematic Solution Methods: Part 1

**Dr. Bonnie Ferri**
Professor and Associate Chair
School of Electrical and
Computer Engineering

*Introduce several ways of obtaining circuit equations.*

# Module 2: Resistive Circuits

- Resistance
- Kirchhoff's Laws
- Resistors
- Superposition
- Systematic Solution Methods
- Maximum Power Transfer
- Applications: Sensors

# Previous Lesson

- Demonstrated the superposition principle for circuits with multiple sources

# Lesson Objective

- Introduce
  - Mesh analysis
  - Node analysis
  - Thévenin equivalent circuit
  - Norton equivalent circuit

# Physical Behavior

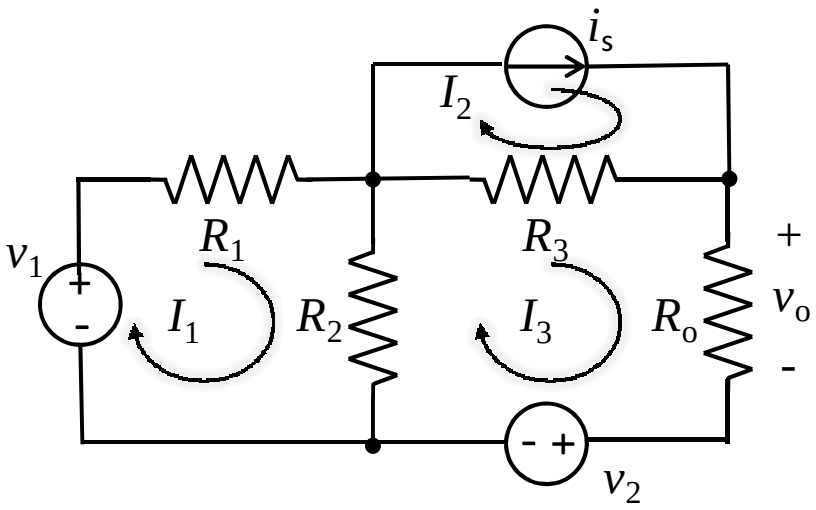
- Ohm's Law
  - $V = iR$
- KVL
  - sum of all voltages around any loop = 0
- KCL
  - sum of all currents out of any node = 0

# Systematic Ways to Solve Circuit Problems

| Method | Summary |
|---|---|
| Mesh Analysis | Systematic KVL to obtain simultaneous equations for currents |
| Node Analysis | Systematic KCL to obtain simultaneous equations for voltages |
| Thévenin and Norton Equivalent Circuits | • Reduce circuit to smaller equivalent<br>• Source transformations using graphical method |

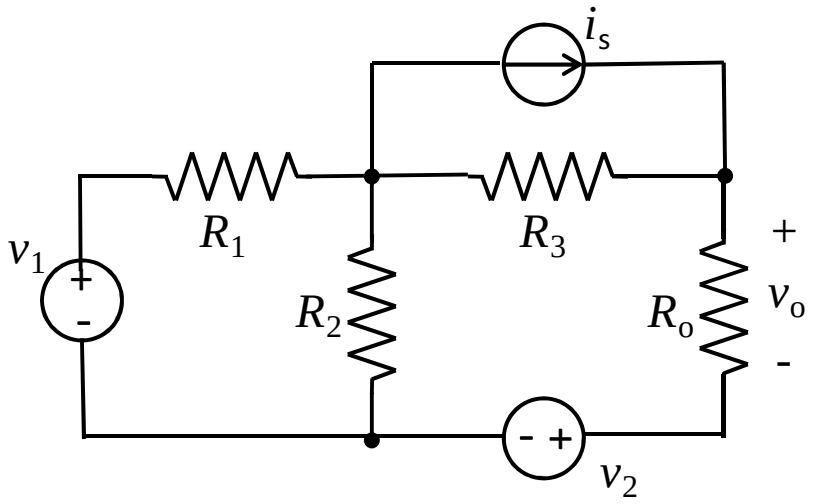
# Mesh Analysis

1. Define mesh currents, one for each non-inclusive loop
2. Do KVL around each loop



# Node Analysis

1. Select a ground node
2. Define node voltages for every node connected to 3 or more elements
3. Do KCL at every node



# Summary

| Method | Summary | When to Apply |
|---|---|---|
| Mesh Analysis | Systematic KVL, simultaneous equations for currents | • Multiple currents are needed<br>• Current sources are present |
| Node Analysis | Systematic KCL, simultaneous equations for voltages | • Multiple voltages are needed<br>• Voltage sources are present |
| Thévenin and Norton Equivalent Circuits | Simple equivalent circuits, source transformations | • Intermediate values not important; only output voltage or current |

# Next Lesson

- Thévenin equivalent circuit and Norton equivalent circuit methods and examples
- Extra worked problems are available for these two lessons